

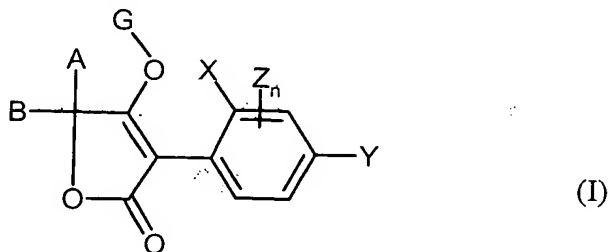
Active compound combinations having insecticidal and acaricidal properties

5 The present invention relates to novel active compound combinations comprising known cyclic ketoenols on the one hand and other known insecticidally active compounds on the other hand and which are highly suitable for controlling animal pests such as insects and undesired acarids.

10 It is already known that certain cyclic ketoenols have insecticidal and acaricidal properties (EP-A-528 156). Further ketoenols having insecticidal and acaricidal properties are described in WO 95/01971, EP-A-647 637, WO 96/16061, WO 96/20196, WO 96/25395, WO 96/35664, WO 97/02243, WO 97/01535, WO 97/36868, WO 97/43275, WO 98/05638, WO 98/06721, WO 99/16748, WO 99/43649, WO 99/48869 and WO 99/55673. The activity of these substances is
15 good; however, at low application rates it is sometimes unsatisfactory.

Furthermore, it is already known that numerous heterocycles, organotin compounds, benzoylureas and pyrethroids have insecticidal and acaricidal properties (cf. WO 93-
20 22 297, WO 93-10 083, DE-A 2 641 343, EP-A-347 488, EP-A-210 487, US-A 3 264 177 and EP-A-234 045). However, the activity of these substances is not always satisfactory.

It has now been found that compounds of the formula (I)



in which

X represents C₁-C₆-alkyl, halogen, C₁-C₆-alkoxy or C₁-C₃-halogenoalkyl,

Donna J. Veatch

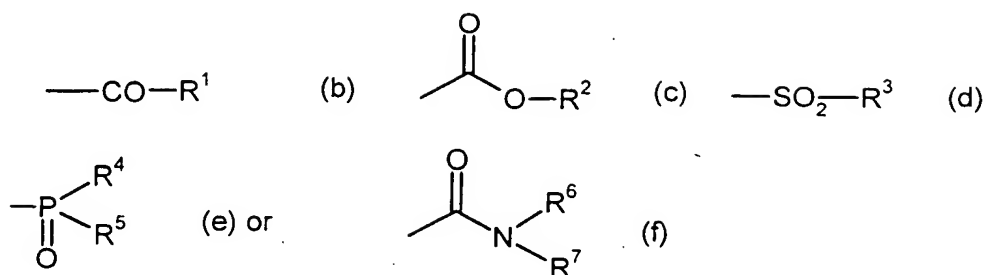
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- Y represents hydrogen, C₁-C₆-alkyl, halogen, C₁-C₆-alkoxy or C₁-C₃-halogenoalkyl,
- 5 Z represents C₁-C₆-alkyl, halogen or C₁-C₆-alkoxy,
- n represents a number from 0 to 3,
- 10 A represents hydrogen or in each case optionally halogen-substituted straight-chain or branched C₁-C₁₂-alkyl, C₃-C₈-alkenyl, C₃-C₈-alkinyl, C₁-C₁₀-alkoxy-C₂-C₈-alkyl, C₁-C₈-polyalkoxy-C₂-C₈-alkyl, C₁-C₁₀-alkylthio-C₂-C₈-alkyl or cycloalkyl having 3-8 ring atoms which may be interrupted by oxygen and/or sulphur and represents in each case optionally halogen-, C₁-C₆-alkyl-, C₁-C₆-halogenoalkyl-, C₁-C₆-alkoxy-, C₁-C₆-halogenoalkoxy- or nitro-substituted phenyl or phenyl-C₁-C₆-alkyl,
- 15
- B represents hydrogen, C₁-C₆-alkyl or C₁-C₆-alkoxy-C₂-C₄-alkyl
- or in which
- 20
- A and B together with the carbon atom to which they are attached form a saturated or unsaturated 3- to 8-membered ring which is optionally interrupted by oxygen and/or sulphur and optionally substituted by halogen, C₁-C₆-alkyl, C₁-C₆-alkoxy, C₁-C₄-halogenoalkyl, C₁-C₄-halogenoalkoxy, C₁-C₄-alkylthio or
- 25 optionally substituted phenyl or is optionally benzo-fused,
- G represents hydrogen (a) or represents a group



in which

5 R^1 represents in each case optionally halogen-substituted C_1 - C_{20} -alkyl, C_2 - C_{20} -alkenyl, C_1 - C_8 -alkoxy- C_2 - C_8 -alkyl, C_1 - C_8 -alkylthio- C_2 - C_8 -alkyl, C_1 - C_8 -polyalkoxy- C_2 - C_8 -alkyl or cycloalkyl having 3-8 ring atoms which may be interrupted by oxygen and/or sulphur atoms,

10 represents optionally halogen-, nitro-, C_1 - C_6 -alkyl-, C_1 - C_6 -alkoxy-, C_1 - C_6 -halogenoalkyl- or C_1 - C_6 -halogenoalkoxy-substituted phenyl,

represents optionally halogen-, C_1 - C_6 -alkyl-, C_1 - C_6 -alkoxy-, C_1 - C_6 -halogenoalkyl- or C_1 - C_6 -halogenoalkoxy-substituted phenyl- C_1 - C_6 -alkyl,

15 represents in each case optionally halogen- and/or C_1 - C_6 -alkyl-substituted pyridyl, pyrimidyl, thiazolyl or pyrazolyl,

represents optionally halogen- and/or C_1 - C_6 -alkyl-substituted phenoxy- C_1 - C_6 -alkyl,

20

R^2 represents in each case optionally halogen-substituted C_1 - C_{20} -alkyl, C_2 - C_{20} -alkenyl, C_1 - C_8 -alkoxy- C_2 - C_8 -alkyl or C_1 - C_8 -polyalkoxy- C_2 - C_8 -alkyl,

25 represents in each case optionally halogen-, nitro-, C_1 - C_6 -alkyl-, C_1 - C_6 -alkoxy- or C_1 - C_6 -halogenoalkyl-substituted phenyl or benzyl,

R³ represents optionally halogen-substituted C₁-C₈-alkyl, represents in each case optionally C₁-C₄-alkyl-, halogen-, C₁-C₄-halogenoalkyl-, C₁-C₄-alkoxy-, C₁-C₄-halogenoalkoxy-, nitro- or cyano-substituted phenyl or benzyl,

5 R⁴ and R⁵ independently of one another represent in each case optionally halogen-substituted C₁-C₈-alkyl, C₁-C₈-alkoxy, C₁-C₈-alkylamino, di-(C₁-C₈)-alkyl-amino, C₁-C₈-alkylthio, C₂-C₅-alkenylthio, C₂-C₅-alkinylthio or C₃-C₇-cycloalkylthio, represent in each case optionally halogen-, nitro-, cyano-, C₁-C₄-alkoxy-, C₁-C₄-halogenoalkoxy-, C₁-C₄-alkylthio-, C₁-C₄-halogeno-
10 alkylthio-, C₁-C₄-alkyl- or C₁-C₄-halogenoalkyl-substituted phenyl, phenoxy or phenylthio,

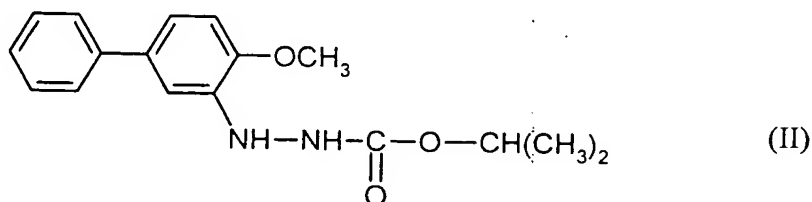
R⁶ and R⁷ independently of one another represent in each case optionally halogen-substituted C₁-C₁₀-alkyl, C₁-C₁₀-alkoxy, C₃-C₈-alkenyl or C₁-C₈-alkoxy-C₁-C₈-alkyl, represent optionally halogen-, C₁-C₆-halogenoalkyl-, C₁-C₆-alkyl-
15 or C₁-C₆-alkoxy-substituted phenyl, represent optionally halogen-, C₁-C₆-alkyl-, C₁-C₆-halogenoalkyl- or C₁-C₆-alkoxy-substituted benzyl or together represent a 5- or 6-membered ring which is optionally interrupted by oxygen or sulphur and which may optionally be substituted by C₁-C₆-alkyl,

20

and bioactive compounds, preferably

(1) the phenylhydrazine derivative of the formula

25



(bifenthrin)

known from WO 93/10 083

and/or

(2) the macrolide with the common name

5

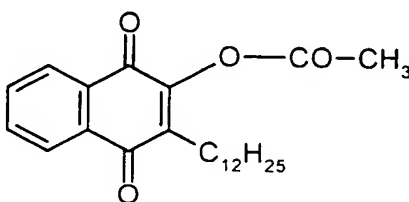
abamectin (III)

known from DE-A-27 17 040

10

and/or

(3) the naphthalenedione derivative of the formula



(IV)

15

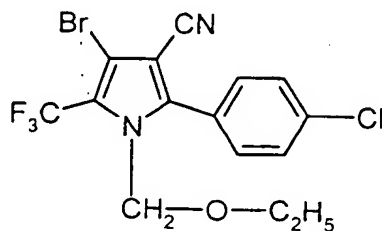
(acequinocyl)

known from DE-A-26 41 343

and/or

20

(4) the pyrrole derivative of the formula



(V)

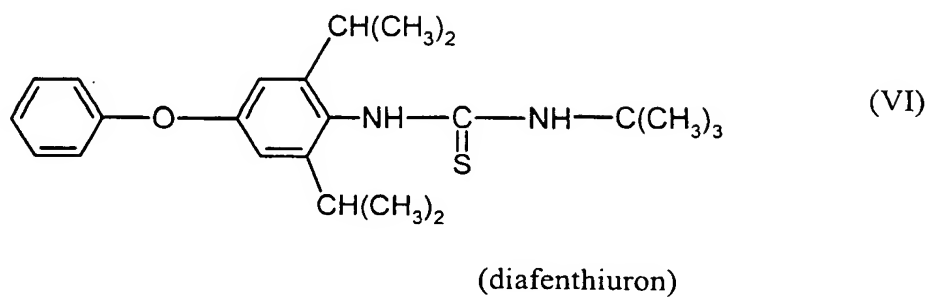
(chlorfenapyr)

known from EP-A-347 488

and/or

5

(5) the thiourea derivative of the formula



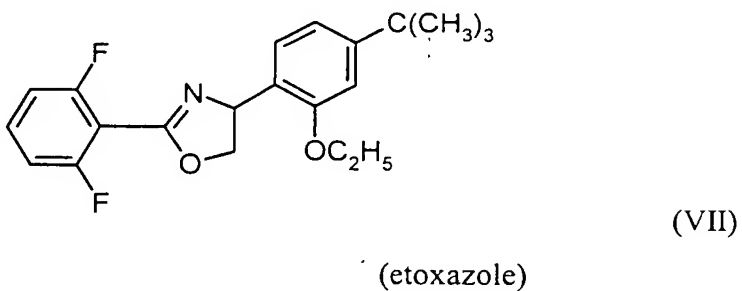
10

known from EP-A-210 487

and/or

(6) the oxazoline derivative of the formula

15

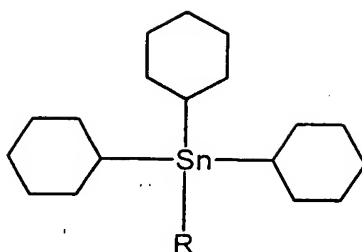


known from WO 93/22 297

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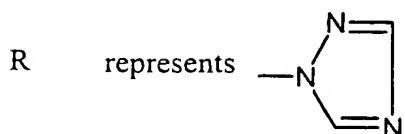
and/or

(7) an organotin derivative of the formula



(VIII)

in which



(VIIIa = azocyclotin),

known from The Pesticide Manual, 9th edition, p.48

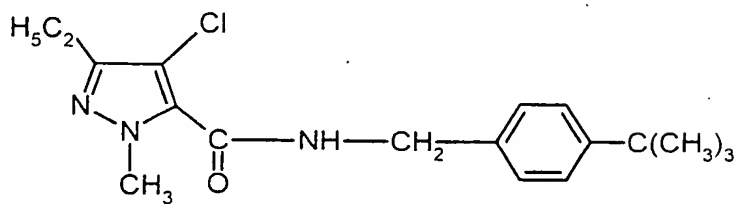
or

R represents -OH
(VIIIb = cyhexatin),

known from US 3,264,177

and/or

(8) the pyrazole derivative of the formula



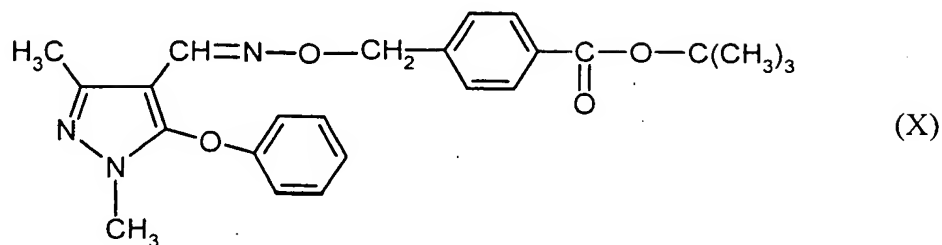
(IX)

(tebufenpyrad)

known from EP-A-289 879

and/or

5 (9) the pyrazole derivative of the formula

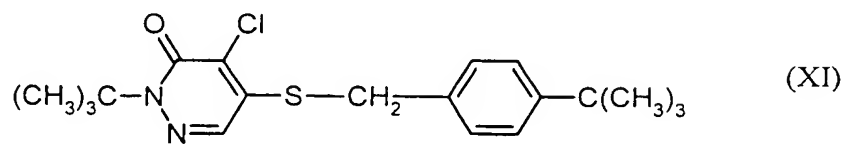


(fenpyroximate)

10 known from EP-A-234 045

and/or

15 (10) the pyridazinone derivative of the formula



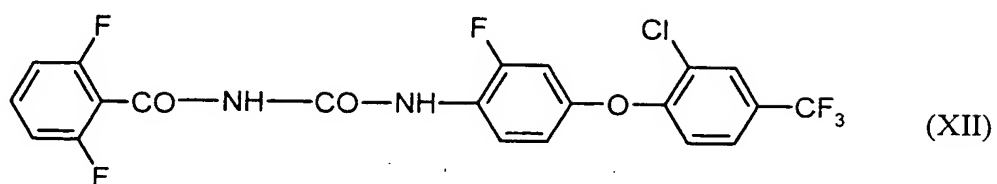
(pyridaben)

known from EP-A-134 439

20

and/or

(11) the benzoylurea of the formula

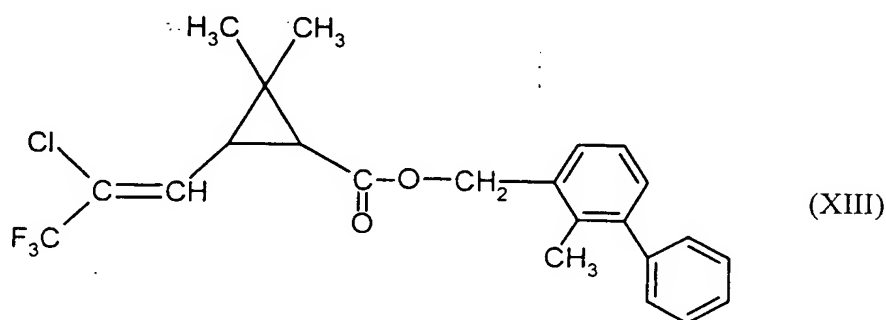


(flufenoxuron)

known from EP-A-161 019

5 and/or

(12) the pyrethroid of the formula



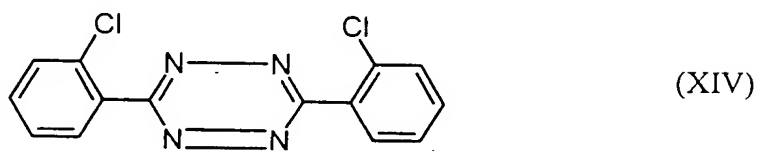
(bifenthrin)

known from EP-A-049 977

and/or

15

(13) the tetrazine derivative of the formula



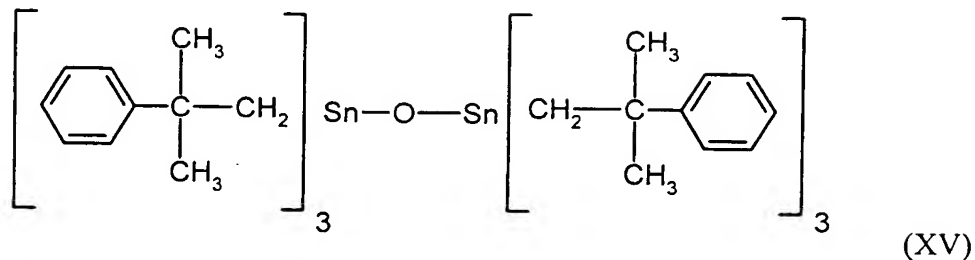
(clofentezine)

20

known from EP-A-005 912

and/or

(14) the organotin derivative of the formula



5

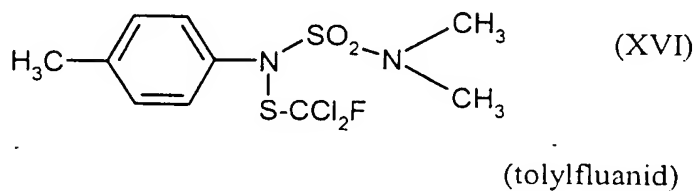
(fenbutatin oxide)

known from DE-A-2 115 666

and/or

10

(15) the sulphenamide of the formula

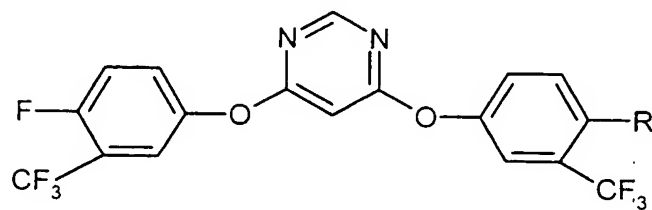


known from The Pesticide Manual, 11th edition, 1997, page 1208

15

and/or

(16) the pyrimidyl phenol ethers



20

R = Cl (XVII); 4-[(4-chloro- α,α,α -trifluoro-3-tolyl)oxy]-6-[(α,α,α -tetrafluoro-3-tolyl)oxy]-pyrimidine)

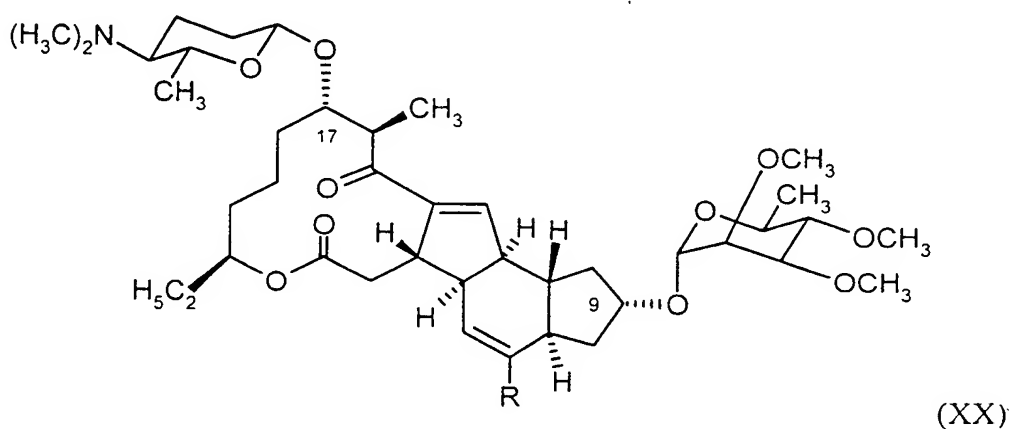
R = NO₂ (XVIII); 4-[(4-chloro- α,α,α -trifluoro-3-tolyl)oxy]-6-[(α,α,α -trifluoro-4-nitro-3-tolyl)oxy]-pyrimidine

R = Br (XIX); 4-[(4-chloro- α,α,α -trifluoro-3-tolyl)oxy]-6-[(α,α,α -trifluoro-4-bromo-3-tolyl)oxy]-pyrimidine

known from WO 94/02 470, EP-A-883 991

and/or

(17) the macrolide of the formula



(spinosad) a mixture preferably comprising

85% spinosyn A R=H

15% spinosyn B R = CH₃

known from EP-A-375 316

and/or

(18) ivermectin (XXI)

known from EP-A-001 689

5 and/or

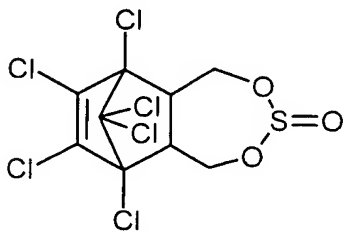
(19) milbemectin (XXII)

known from The Pesticide Manual, 11th edition, 1997, p. 846

10

and/or

(20) endosulfan (XXIII)



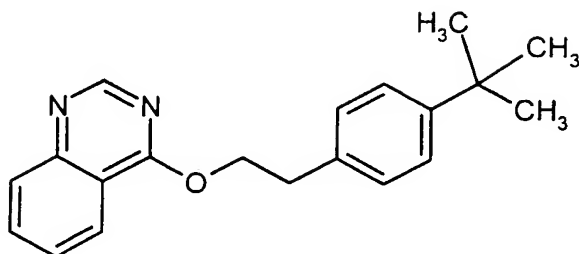
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known from DE-A-1 015 797

and/or

20

(21) fenazaquin (XXIV)

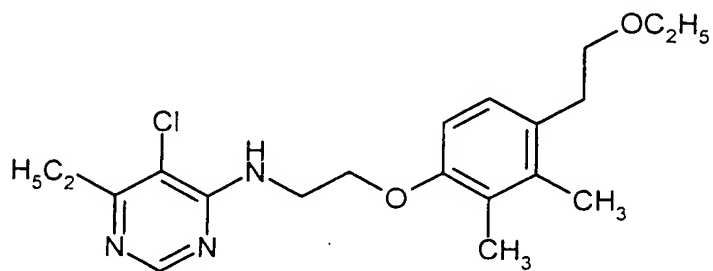


known from EP-A-326 329

5

and/or

(22) pyrimidifen (XXV)



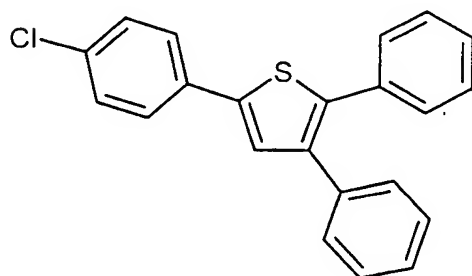
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known from EP-A-196 524

and/or

(23) triarathen (XXVI)

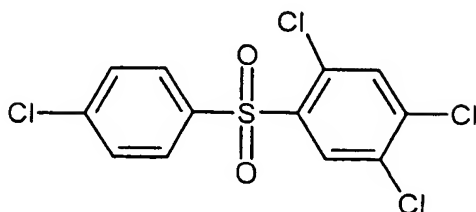
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known from DE-A-2 724 494

and/or

5 (24) tetradifon (XXVII)

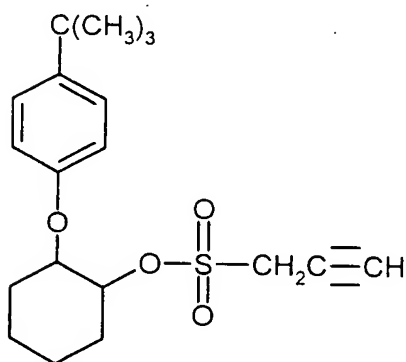


known from US 2,812,281

10

and/or

(25) propargit (XXVIII)



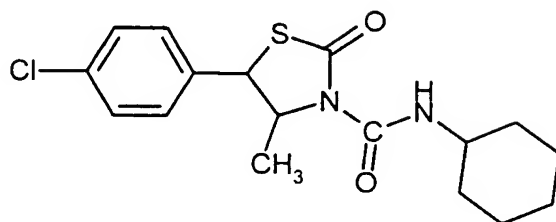
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known from US 3,272,854

and/or

20

(26) hexythiazox (XXIX)

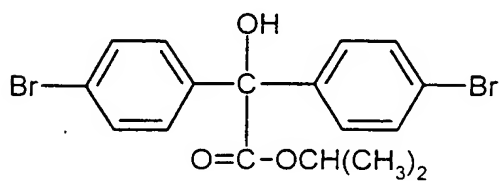


known from DE-A-3 037 105

5

and/or

(27) bromopropylate (XXX)



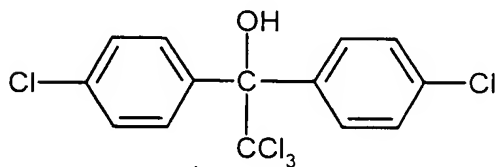
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known from US 3,784,696

and/or

15

(28) dicofol (XXXI)

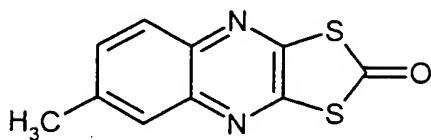


20

known from US 2,812,280

and/or

(29) chinomethionat (XXXII)



5

known from DE-A-1 100 372

have very good insecticidal and acaricidal properties.

10 Surprisingly, the insecticidal and acaricidal action of the active compound combinations according to the invention considerably exceeds the total of the actions of the individual active compounds. A true synergistic effect which could not have been predicted therefore exists, not just a complementation of action.

15 The active compound combinations according to the invention comprise, in addition to at least one active compound of the formula (I), at least one active compound of compounds 1 to 29.

20 Preference is given to active compound combinations comprising compounds of the formula (I)

in which

25 X represents C₁-C₄-alkyl, halogen, C₁-C₄-alkoxy or C₁-C₂-halogenoalkyl,

Y represents hydrogen, C₁-C₄-alkyl, halogen, C₁-C₄-alkoxy or C₁-C₂-halogenoalkyl,

Z represents C₁-C₄-alkyl, halogen or C₁-C₄-alkoxy,

n represents 0 or 1,

5 A and B together with the carbon atom to which they are attached form a saturated, optionally C₁-C₄-alkyl- or C₁-C₄-alkoxy-substituted 5- or 6-membered ring,

G represents hydrogen (a) or represents the groups



10 in which

R¹ represents in each case optionally halogen-substituted C₁-C₁₆-alkyl, C₂-C₁₆-alkenyl, C₁-C₆-alkoxy-C₂-C₆-alkyl or cycloalkyl having 3-7 ring atoms which may be interrupted by 1 or 2 oxygen and/or sulphur atoms,

15

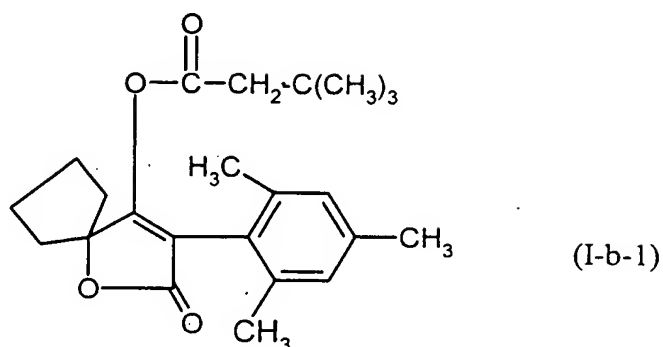
represents optionally halogen-, nitro-, C₁-C₄-alkyl-, C₁-C₄-alkoxy-, C₁-C₃-halogenoalkyl- or C₁-C₃-halogenoalkoxy-substituted phenyl,

20 R² represents in each case optionally halogen-substituted C₁-C₁₆-alkyl, C₂-C₁₆-alkenyl or C₁-C₆-alkoxy-C₂-C₆-alkyl,

represents in each case optionally halogen-, nitro-, C₁-C₄-alkyl-, C₁-C₄-alkoxy- or C₁-C₄-halogenoalkyl-substituted phenyl or benzyl,

25 and at least one active compound of compounds 1 to 29.

Particular preference is given to active compound combinations comprising the dihydrofuranone derivative of the formula (I-b-1)



and at least one active compound of compounds 1 to 29.

5 In addition, the active compound combinations may also comprise other fungicidally, acaricidally or insecticidally active components which may be admixed.

10 If the active compounds are present in the active compound combinations according to the invention in certain weight ratios, the synergistic effect is particularly pronounced. However, the weight ratios of the active compounds in the active compound combinations may be varied within a relatively wide range. In general, the combinations according to the invention comprise active compounds of the formula (I) and the co-components in the preferred and particularly preferred mixing ratios indicated in the table below:

15 * the mixing ratios are based on weight ratios. The ratio is to be understood as meaning active compound of the formula (I): co-component

Co-component	Preferred mixing ratio	Particularly preferred mixing ratio
bifenazate	5:1 to 1:20	1:1 to 1:10
abamectin	50:1 to 1:5	10:1 to 1:1
acequinocyl	10:1 to 1:10	5:1 to 1:5
chlorfenapyr	10:1 to 1:10	5:1 to 1:5
diafenthiuron	10:1 to 1:10	5:1 to 1:5
etoxazole	20:1 to 1:5	10:1 to 1:2

Co-component	Preferred mixing ratio	Particularly preferred mixing ratio
azocyclotin	10:1 to 1:10	5:1 to 1:5
cyhexatin	10:1 to 1:10	5:1 to 1:5
tebufenpyrad	20:1 to 1:10	10:1 to 1:5
fenpyroximat	10:1 to 1:10	5:1 to 1:5
pyridaben	10:1 to 1:10	5:1 to 1:5
flufenoxuron	10:1 to 1:10	5:1 to 1:5
bifenthrin	10:1 to 1:10	5:1 to 1:5
clofentezine	10:1 to 1:10	5:1 to 1:5
fenbutatin oxide	10:1 to 1:10	5:1 to 1:5
tolyfluanid	5:1 to 1:50	1:1 to 1:5
pyrimidyl phenol ethers (XVII-XIX)	10:1 to 1:10	5:1 to 1:5
spinosad	10:1 to 1:10	5:1 to 1:5
ivermectin	50:1 to 1:5	10:1 to 1:1
milbemectin	50:1 to 1:5	10:1 to 1:1
endosulfan	10:1 to 1:10	5:1 to 1:5
fenazaquin	10:1 to 1:10	5:1 to 1:5
pyrimidifen	50:1 to 1:5	10:1 to 1:1
triarathen	5:1 to 1:20	1:1 to 1:10
tetradifon	10:1 to 1:10	5:1 to 1:5
propargit	10:1 to 1:10	5:1 to 1:5
hexythiazox	20:1 to 1:5	10:1 to 1:2
bromopropylate	10:1 to 1:10	5:1 to 1:5
dicofol	10:1 to 1:10	5:1 to 1:5
chinomethionat	10:1 to 1:10	5:1 to 1:5

The active compound combinations according to the invention are suitable for controlling animal pests, preferably arthropods and nematodes, in particular insects and arachnids found in agriculture, in animal health, in forests, in the protection of stored products and materials and in the hygiene sector. They are active against

normally sensitive and resistant species, and against all or individual developmental stages. The abovementioned pests include:

- 5 From the order of the Isopoda, for example, *Oniscus asellus*, *Armadillidium vulgare*,
Porcellio scaber.
- From the order of the Diplopoda, for example, *Blaniulus guttulatus*.
- From the order of the Chilopoda, for example, *Geophilus carpophagus*, *Scutigera*
spp..
- From the order of the Symphyla, for example, *Scutigera immaculata*.
- 10 From the order of the Thysanura, for example, *Lepisma saccharina*.
- From the order of the Collembola, for example, *Onychiurus armatus*.
- From the order of the Orthoptera, for example, *Acheta domesticus*, *Gryllotalpa* spp.,
Locusta migratoria migratorioides, *Melanoplus* spp., *Schistocerca gregaria*.
- From the order of the Blattaria, for example, *Blatta orientalis*, *Periplaneta americana*,
15 *Leucophaea maderae*, *Blattella germanica*.
- From the order of the Dermaptera, for example, *Forficula auricularia*.
- From the order of the Isoptera, for example, *Reticulitermes* spp..
- From the order of the Phthiraptera, for example, *Pediculus humanus corporis*,
Haematopinus spp., *Linognathus* spp., *Trichodectes* spp., *Damalinia* spp..
- 20 From the order of the Thysanoptera, for example, *Hercinothrips femoralis*, *Thrips*
tabaci, *Thrips palmi*, *Frankliniella occidentalis*.
- From the order of the Heteroptera, for example, *Eurygaster* spp., *Dysdercus*
intermedius, *Piesma quadrata*, *Cimex lectularius*, *Rhodnius prolixus*, *Triatoma* spp..
- From the order of the Homoptera, for example, *Aleurodes brassicae*, *Bemisia tabaci*,
25 *Trialeurodes vaporariorum*, *Aphis gossypii*, *Brevicoryne brassicae*, *Cryptomyzus*
ribis, *Aphis fabae*, *Aphis pomi*, *Eriosoma lanigerum*, *Hyalopterus arundinis*,
Phylloxera vastatrix, *Pemphigus* spp., *Macrosiphum avenae*, *Myzus* spp., *Phorodon*
humuli, *Rhopalosiphum padi*, *Empoasca* spp., *Euscelis bilobatus*, *Nephotettix*
cincticeps, *Lecanium corni*, *Saissetia oleae*, *Laodelphax striatellus*, *Nilaparvata*
30 *lugens*, *Aonidiella aurantii*, *Aspidiotus hederae*, *Pseudococcus* spp., *Psylla* spp..

From the order of the Lepidoptera, for example, *Pectinophora gossypiella*, *Bupalus piniarius*, *Cheimatobia brumata*, *Lithocolletis blancardella*, *Hyponomeuta padella*, *Plutella xylostella*, *Malacosoma neustria*, *Euproctis chrysorrhoea*, *Lymantria* spp., *Bucculatrix thurberiella*, *Phyllocnistis citrella*, *Agrotis* spp., *Euxoa* spp., *Feltia* spp.,
 5 *Earias insulana*, *Heliothis* spp., *Mamestra brassicae*, *Panolis flammea*, *Spodoptera* spp., *Trichoplusia ni*, *Carpocapsa pomonella*, *Pieris* spp., *Chilo* spp., *Pyrausta nubilalis*, *Ephestia kuehniella*, *Galleria mellonella*, *Tineola bisselliella*, *Tinea pellionella*, *Hofmannophila pseudospretella*, *Cacoecia podana*, *Capua reticulana*, *Choristoneura fumiferana*, *Clysia ambiguella*, *Homona magnanima*, *Tortrix viridana*,
 10 *Cnaphalocerus* spp., *Oulema oryzae*.

From the order of the Coleoptera, for example, *Anobium punctatum*, *Rhizopertha dominica*, *Bruchidius obtectus*, *Acanthoscelides obtectus*, *Hylotrupes bajulus*, *Agelastica alni*, *Leptinotarsa decemlineata*, *Phaedon cochleariae*, *Diabrotica* spp., *Psylliodes chrysocephala*, *Epilachna varivestis*, *Atomaria* spp., *Oryzaephilus*
 15 *surinamensis*, *Anthonomus* spp., *Sitophilus* spp., *Otiorrhynchus sulcatus*, *Cosmopolites sordidus*, *Ceuthorrhynchus assimilis*, *Hypera postica*, *Dermestes* spp., *Trogoderma* spp., *Anthrenus* spp., *Attagenus* spp., *Lyctus* spp., *Meligethes aeneus*, *Ptinus* spp., *Niptus hololeucus*, *Gibbium psylloides*, *Tribolium* spp., *Tenebrio molitor*, *Agriotes* spp., *Conoderus* spp., *Melolontha melolontha*, *Amphimallon solstitialis*, *Costelytra zealandica*, *Lissorhoptrus oryzophilus*.
 20

From the order of the Hymenoptera, for example, *Diprion* spp., *Hoplocampa* spp., *Lasius* spp., *Monomorium pharaonis*, *Vespa* spp..

From the order of the Diptera, for example, *Aedes* spp., *Anopheles* spp., *Culex* spp., *Drosophila melanogaster*, *Musca* spp., *Fannia* spp., *Calliphora erythrocephala*,
 25 *Lucilia* spp., *Chrysomya* spp., *Cuterebra* spp., *Gastrophilus* spp., *Hyppobosca* spp., *Stomoxys* spp., *Oestrus* spp., *Hypoderma* spp., *Tabanus* spp., *Tannia* spp., *Bibio hortulanus*, *Oscinella frit*, *Phorbia* spp., *Pegomyia hyoscyami*, *Ceratitis capitata*, *Dacus oleae*, *Tipula paludosa*, *Hylemyia* spp., *Liriomyza* spp..

From the order of the Siphonaptera, for example, *Xenopsylla cheopis*, *Ceratophyllus* spp..
 30

From the class of the Arachnida, for example, *Scorpio maurus*, *Latrodectus mactans*,
Acarus siro, *Argas* spp., *Ornithodoros* spp., *Dermanyssus gallinae*, *Eriophyes ribis*,
Phyllocoptruta oleivora, *Boophilus* spp., *Rhipicephalus* spp., *Amblyomma* spp.,
Hyalomma spp., *Ixodes* spp., *Psoroptes* spp., *Chorioptes* spp., *Sarcoptes* spp.,
5 *Tarsonemus* spp., *Bryobia praetiosa*, *Panonychus* spp., *Tetranychus* spp.,
Hemitarsonemus spp., *Brevipalpus* spp..

The plant-parasitic nematodes include, for example, *Pratylenchus* spp., *Radopholus*
similis, *Ditylenchus dipsaci*, *Tylenchulus semipenetrans*, *Heterodera* spp., *Globodera*
10 spp., *Meloidogyne* spp., *Aphelenchoides* spp., *Longidorus* spp., *Xiphinema* spp.,
Trichodorus spp., *Bursaphelenchus* spp..

The active compound combinations can be converted into the customary
formulations such as solutions, emulsions, wettable powders, suspensions, powders,
15 dusts, pastes, soluble powders, granules, suspension-emulsion concentrates, natural
and synthetic materials impregnated with active compound, and microencapsulations
in polymeric materials.

These formulations are produced in a known manner, for example by mixing the
20 active compounds with extenders, that is, liquid solvents and/or solid carriers,
optionally with the use of surfactants, that is, emulsifiers and/or dispersants, and/or
foam formers.

If the extender used is water, it is also possible, for example, to use organic solvents
25 as cosolvents. The following are essentially suitable as liquid solvents: aromatics
such as xylene, toluene or alkylnaphthalenes, chlorinated aromatics and chlorinated
aliphatic hydrocarbons such as chlorobenzenes, chloroethylenes and methylene
chloride, aliphatic hydrocarbons such as cyclohexane or paraffins, for example
mineral oil fractions, mineral and vegetable oils, alcohols such as butanol or glycol
30 and their ethers and esters, ketones such as acetone, methyl ethyl ketone, methyl

isobutyl ketone or cyclohexanone, strongly polar solvents such as dimethylformamide and dimethyl sulphoxide, or else water.

Suitable solid carriers are:

5 for example ammonium salts and ground natural minerals such as kaolins, clays, talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth, and ground synthetic materials such as highly-disperse silica, alumina and silicates; suitable solid carriers for granules are: for example crushed and fractionated natural rocks such as calcite, marble, pumice, sepiolite and dolomite, or else synthetic granules of
10 inorganic and organic meals, and granules of organic material such as sawdust, coconut shells, maize cobs and tobacco stalks; suitable emulsifiers and/or foam formers are: for example nonionic and anionic emulsifiers such as polyoxyethylene fatty acid esters, polyoxyethylene fatty alcohol ethers, for example alkylaryl polyglycol ethers, alkylsulphonates, alkyl sulphates, arylsulphonates, or else protein
15 hydrolysates; suitable dispersants are: for example lignin-sulphite waste liquors and methylcellulose.

Tackifiers such as carboxymethylcellulose and natural and synthetic polymers in the form of powders, granules or latices, such as gum arabic, polyvinyl alcohol and
20 polyvinyl acetate, or else natural phospholipids such as cephalins and lecithins and synthetic phospholipids can be used in the formulations. Other additives can be mineral and vegetable oils.

It is possible to use colorants such as inorganic pigments, for example iron oxide, titanium oxide and Prussian Blue, and organic colorants such as alizarin colorants, azo
25 colorants and metal phthalocyanine colorants, and trace nutrients such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc.

The formulations generally comprise between 0.1 and 95% by weight of active
30 compound, preferably between 0.5 and 90%.

The active compound combinations according to the invention can be present in their commercially available formulations and in the use forms, prepared from these formulations, as a mixture with other active compounds, such as insecticides, attractants, sterilants, bactericides, acaricides, nematocides, fungicides, growth-regulating substances or herbicides. The insecticides include, for example, phosphates, carbamates, carboxylates, chlorinated hydrocarbons, phenylureas and substances produced by microorganisms.

Mixtures with other known active compounds such as herbicides or with fertilizers and growth regulators are also possible.

When used as insecticides, the active compound combinations according to the invention can furthermore be present in their commercially available formulations and in the use forms, prepared from these formulations, as a mixture with synergists. Synergists are compounds which increase the action of the active compounds, without it being necessary for the synergist added to be active itself.

The active compound content of the use forms prepared from the commercially available formulations can vary within wide limits. The active compound concentration of the use forms can be from 0.0000001 to 95% by weight of active compound, preferably between 0.0001 and 1% by weight.

The compounds are employed in a customary manner appropriate for the use forms.

When used against hygiene pests and stored-product pests, the active compound combinations are distinguished by an excellent residual action on wood and clay as well as good stability to alkali on limed substrates.

The active compound combinations according to the invention are not only active against plant pests, hygiene pests and stored-product pests, but also, in the veterinary medicine sector, against animal parasites (ectoparasites) such as hard ticks, soft ticks,

mange mites, harvest mites, flies (stinging and licking), parasitizing fly larvae, lice, hair lice, bird lice and fleas. These parasites include:

From the order of the Anoplurida, for example, *Haematopinus* spp., *Linognathus* spp., *Pediculus* spp., *Phtirus* spp., *Solenopotes* spp..

- 5 From the order of the Mallophagida and the suborders Amblycerina and Ischnocerina, for example, *Trimenopon* spp., *Menopon* spp., *Trinoton* spp., *Bovicola* spp., *Werneckiella* spp., *Lepikentron* spp., *Damalina* spp., *Trichodectes* spp., *Felicola* spp..

- 10 From the order Diptera and the suborders Nematocerina and Brachycerina, for example, *Aedes* spp., *Anopheles* spp., *Culex* spp., *Simulium* spp., *Eusimulium* spp., *Phlebotomus* spp., *Lutzomyia* spp., *Culicoides* spp., *Chrysops* spp., *Hybomitra* spp., *Atylotus* spp., *Tabanus* spp., *Haematopota* spp., *Philipomyia* spp., *Braula* spp., *Musca* spp., *Hydrotaea* spp., *Stomoxys* spp., *Haematobia* spp., *Morellia* spp., *Fannia* spp., *Glossina* spp., *Calliphora* spp., *Lucilia* spp., *Chrysomyia* spp., *Wohlfahrtia* spp.,
15 *Sarcophaga* spp., *Oestrus* spp., *Hypoderma* spp., *Gasterophilus* spp., *Hippobosca* spp., *Lipoptena* spp., *Melophagus* spp..

From the order of the Siphonapterida, for example, *Pulex* spp., *Ctenocephalides* spp., *Xenopsylla* spp., *Ceratophyllus* spp..

- 20 From the order of the Heteropterida, for example, *Cimex* spp., *Triatoma* spp., *Rhodnius* spp., *Panstrongylus* spp..

From the order of the Blattarida, for example, *Blatta orientalis*, *Periplaneta americana*, *Blattella germanica*, *Supella* spp..

- From the subclass of the Acaria (Acarida) and the order of the Meta- and Mesostigmata, for example, *Argas* spp., *Ornithodoros* spp., *Otobius* spp., *Ixodes* spp.,
25 *Amblyomma* spp., *Boophilus* spp., *Dermacentor* spp., *Haemophysalis* spp., *Hyalomma* spp., *Rhipicephalus* spp., *Dermanyssus* spp., *Raillietia* spp., *Pneumonyssus* spp., *Sternostoma* spp., *Varroa* spp..

- From the order of the Actinedida (Prostigmata) and Acaridida (Astigmata), for example, *Acarapis* spp., *Cheyletiella* spp., *Ornithocheyletia* spp., *Myobia* spp.,
30 *Psorergates* spp., *Demodex* spp., *Trombicula* spp., *Listrophorus* spp., *Acarus* spp., *Tyrophagus* spp., *Caloglyphus* spp., *Hypodectes* spp., *Pterolichus* spp., *Psoroptes*

spp., Chorioptes spp., Otodectes spp., Sarcoptes spp., Notoedres spp., Knemidocoptes spp., Cytodites spp., Laminosioptes spp..

5 The active compound combinations according to the invention are also suitable for controlling arthropods which attack agricultural livestock such as, for example, cattle, sheep, goats, horses, pigs, donkeys, camels, buffaloes, rabbits, chickens, turkeys, ducks, geese, honey-bees, other domestic animals such as, for example, dogs, cats, caged birds, aquarium fish and so-called experimental animals such as, for example, hamsters, guinea pigs, rats and mice. By controlling these arthropods, cases
10 of death and reductions in productivity (for meat, milk, wool, hides, eggs, honey and the like) should be diminished, so that more economical and simpler animal husbandry is possible by the use of the active compound combinations according to the invention.

15 The active compound combinations according to the invention are used in the veterinary sector in a known manner by enteral administration in the form of, for example, tablets, capsules, potions, drenches, granules, pastes, boluses, the feed-through method, suppositories, by parenteral administration such as, for example, by injections (intramuscularly, subcutaneously, intravenously, intraperitoneally and the
20 like), implants, by nasal administration, by dermal administration in the form of, for example, immersing or dipping, spraying, pouring-on, spotting-on, washing, dusting, and with the aid of active-compound-comprising moulded articles such as collars, ear tags, tail tags, limb bands, halters, marking devices and the like.

25 When used for cattle, poultry, domestic animals and the like, the active compound combinations can be applied as formulations (for example powders, emulsions, flowables) comprising the active compounds in an amount of 1 to 80% by weight, either directly or after 100- to 10,000-fold dilution, or they may be used as a chemical dip.

Moreover, it has been found that the active compound combinations according to the invention show a potent insecticidal action against insects which destroy industrial materials.

5 The following insects may be mentioned by way of example and with preference, but not by way of limitation:

Beetles such as

10 Hylotrupes bajulus, Chlorophorus pilosis, Anobium punctatum, Xestobium rufovillosum, Ptilinus pecticornis, Dendrobium pertinex, Emobius mollis, Priobium carpini, Lyctus brunneus, Lyctus africanus, Lyctus planicollis, Lyctus linearis, Lyctus pubescens, Trogoxylon aequale, Minthes rugicollis, Xyleborus spec., Tryptodendron spec., Apate monachus, Bostrychus capucins, Heterobostrychus brunneus, Sinoxylon spec., Dinoderus minutus.

Dermapterans such as

15 Sirex juvencus, Urocerus gigas, Urocerus gigas taignus, Urocerus augur.

Termites such as

Kaloterms flavicollis, Cryptoterms brevis, Heteroterms indicola, Reticulitermes flavipes, Reticulitermes santonensis, Reticulitermes lucifugus, Mastoterms darwiniensis, Zootermopsis nevadensis, Coptoterms formosanus.

20 Bristle-tails such as Lepisma saccharina.

Industrial materials in the present context are understood as meaning non-living materials such as, preferably, polymers, adhesives, glues, paper and board, leather, wood, timber products and paints.

25

The material which is to be protected from insect attack is very especially preferably wood and timber products.

30 Wood and timber products which can be protected by the composition according to the invention, or mixtures comprising it, are to be understood as meaning, for example:

Construction timber, wooden beams, railway sleepers, bridge components, jetties, vehicles made of wood, boxes, pallets, containers, telephone poles, wood lagging, windows and doors made of wood, plywood, chipboard, joinery, or timber products which quite generally are used in house construction or building joinery.

5

The active compound combinations can be used as such, in the form of concentrates or generally customary formulations such as powders, granules, solutions, suspensions, emulsions or pastes.

10

The abovementioned formulations can be prepared in a manner known per se, for example by mixing the active compounds with at least one solvent or diluent, emulsifier, dispersant and/or binder or fixative, water repellant, if desired desiccants and UV stabilizers, and if desired colorants and pigments and other processing auxiliaries.

15

The insecticidal compositions or concentrates used for protecting wood and timber products comprise the active compound according to the invention in a concentration of 0.0001 to 95% by weight, in particular 0.001 to 60% by weight.

20

The amount of composition or concentrate employed depends on the species and the abundance of the insects and on the medium. The optimal quantity to be employed can be determined in each case by test series upon application. In general, however, it will suffice to employ 0.0001 to 20% by weight, preferably 0.001 to 10% by weight, of the active compound, based on the material to be protected.

25

A suitable solvent and/or diluent is an organochemical solvent or solvent mixture and/or an oily or oil-type organochemical solvent or solvent mixture of low volatility and/or a polar organochemical solvent or solvent mixture and/or water and, if appropriate, an emulsifier and/or wetter.

30

Organochemical solvents which are preferably employed are oily or oil-type solvents with an evaporation number of above 35 and a flash point of above 30°C, preferably above 45°C. Such oily and oil-type solvents which are insoluble in water and of low volatility and which are used are suitable mineral oils or their aromatic fractions or
5 mineral-oil-containing solvent mixtures, preferably white spirit, petroleum and/or alkylbenzene.

Mineral oils with a boiling range of 170 to 220°C, white spirit with a boiling range of 170 to 220°C, spindle oil with a boiling range of 250 to 350°C, petroleum and
10 aromatics with a boiling range of 160 to 280°C, oil of turpentine, and the like are advantageously used.

In a preferred embodiment, liquid aliphatic hydrocarbons with a boiling range of 180 to 210°C or high-boiling mixtures of aromatic and aliphatic hydrocarbons with a
15 boiling range of 180 to 220°C and/or spindle oil and/or monochloronaphthalene, preferably α -monochloronaphthalene are used.

The organic oily or oil-type solvents of low volatility and with an evaporation number of above 35 and a flash point of above 30°C, preferably above 45°C, can be
20 replaced in part by organochemical solvents of high or medium volatility, with the proviso that the solvent mixture also has an evaporation number of above 35 and a flash point of above 30°C, preferably above 45°C, and that the mixture is soluble or emulsifiable in this solvent mixture.

25 In a preferred embodiment, some of the organochemical solvent or solvent mixture or an aliphatic polar organochemical solvent or solvent mixture is replaced. Aliphatic organochemical solvents which contain hydroxyl and/or ester and/or ether groups are preferably used, such as, for example, glycol ethers, esters or the like.

30 Organochemical binders used for the purposes of the present invention are the synthetic resins and/or binding drying oils which are known per se and which can be

diluted in water and/or dissolved or dispersed or emulsified in the organochemical solvents employed, in particular binders composed of, or comprising, an acrylate resin, a vinyl resin, for example polyvinyl acetate, polyester resin, polycondensation or polyaddition resin, polyurethane resin, alkyd resin or modified alkyd resin, phenol
5 resin, hydrocarbon resin such as indene/coumarone resin, silicone resin, drying vegetable and/or drying oils and/or physically drying binders based on a natural and/or synthetic resin.

The synthetic resin employed as binder can be employed in the form of an emulsion,
10 dispersion or solution. Bitumen or bituminous substances may also be used as binders, in amounts of up to 10% by weight. In addition, colorants, pigments, water repellants, odour-masking agents, and inhibitors or anticorrosive agents and the like, all of which are known per se, can be employed.

15 In accordance with the invention, the composition or the concentrate preferably comprises, as organochemical binders, at least one alkyd resin or modified alkyd resin and/or a drying vegetable oil. Alkyd resins which are preferably used in accordance with the invention are those with an oil content of over 45% by weight, preferably 50 to 68% by weight.

20 Some or all of the abovementioned binder can be replaced by a fixative (mixture) or plasticizer (mixture). These additives are intended to prevent volatilization of the active compounds, and also crystallization or precipitation. They preferably replace 0.01 to 30% of the binder (based on 100% of binder employed).

25 The plasticizers are from the chemical classes of the phthalic esters, such as dibutyl phthalate, dioctyl phthalate or benzyl butyl phthalate, phosphoric esters such as tributyl phosphate, adipic esters such as di-(2-ethylhexyl)-adipate, stearates such as butyl stearate or amyl stearate, oleates such as butyl oleate, glycerol ethers or higher-
30 molecular-weight glycol ethers, glycerol esters and p-toluenesulphonic esters.

Fixatives are based chemically on polyvinyl alkyl ethers such as, for example, polyvinyl methyl ether, or ketones such as benzophenone and ethylenebenzophenone.

5 Other suitable solvents or diluents are, in particular, water, if appropriate as a mixture with one or more of the abovementioned organochemical solvents or diluents, emulsifiers and dispersants.

10 Particularly effective timber protection is achieved by industrial-scale impregnating processes, for example the vacuum, double-vacuum or pressure processes.

The active compound combinations according to the invention can at the same time be employed for protecting objects which come into contact with saltwater or brackish water, such as hulls, screens, nets, buildings, moorings and signalling systems, against fouling.

15 Fouling by sessile Oligochaeta, such as Serpulidae, and by shells and species from the Ledamorpha group (goose barnacles), such as various Lepas and Scalpellum species, or by species from the Balanomorpha group (acorn barnacles), such as Balanus or Pollicipes species, increases the frictional drag of ships and, as a
20 consequence, leads to a marked increase in operation costs owing to higher energy consumption and additionally frequent residence in the dry dock.

Apart from fouling by algae, for example Ectocarpus sp. and Ceramium sp., fouling by sessile Entomostraka groups, which come under the generic term Cirripedia
25 (cirriped crustaceans), is of particular importance.

Surprisingly, it has now been found that the active compound combinations according to the invention have an outstanding antifouling action.

30 Using the active compound combinations according to the invention, allows the use of heavy metals such as, for example, in bis(trialkyltin) sulphides, tri-*n*-butyltin

laurate, tri-*n*-butyltin chloride, copper(I) oxide, triethyltin chloride, tri-*n*-butyl(2-phenyl-4-chlorophenoxy)tin, tributyltin oxide, molybdenum disulphide, antimony oxide, polymeric butyl titanate, phenyl-(bispyridine)-bismuth chloride, tri-*n*-butyltin fluoride, manganese ethylenebisthiocarbamate, zinc dimethyldithiocarbamate, zinc ethylenebisthiocarbamate, zinc salts and copper salts of 2-pyridinethiol 1-oxide, bisdimethyldithiocarbamoylzinc ethylene-bisthiocarbamate, zinc oxide, copper(I) ethylene-bisdithiocarbamate, copper thiocyanate, copper naphthenate and tributyltin halides to be dispensed with, or the concentration of these compounds to be substantially reduced.

10

If appropriate, the ready-to-use antifouling paints can additionally comprise other active compounds, preferably algicides, fungicides, herbicides, molluscicides, or other antifouling active compounds.

15

Preferably suitable components in combinations with the antifouling compositions according to the invention are:

algicides such as

2-*tert*-butylamino-4-cyclopropylamino-6-methylthio-1,3,5-triazine, dichlorophen, diuron, endothal, fentine acetate, isoproturon, methabenzthiazuron, oxyfluorfen, quinoclamine and terbutryn;

20

fungicides such as

benzo[*b*]thiophenecarboxylic acid cyclohexylamide S,S-dioxide, dichlofluanid, fluorfolpet, 3-iodo-2-propinyl butylcarbamate, tolylfluanid and azoles such as azaconazole, cyproconazole, epoxyconazole, hexaconazole, metconazole, propiconazole and tebuconazole;

25

molluscicides such as

fentin acetate, metaldehyde, methiocarb, niclosamid, thiodicarb and trimethacarb;

30

or conventional antifouling active compounds such as

4,5-dichloro-2-octyl-4-isothiazolin-3-one, diiodomethylparatryl sulphone, 2-(N,N-dimethylthiocarbamoylthio)-5-nitrothiazyl, potassium, copper, sodium and zinc salts of 2-pyridinethiol 1-oxide, pyridine-triphenylborane, tetrabutyl-distannoxane, 2,3,5,6-tetrachloro-4-(methylsulphonyl)-pyridine, 2,4,5,6-tetrachloroisophthalonitrile, tetramethylthiuram disulphide and 2,4,6-trichlorophenylmaleimide.

The antifouling compositions used comprise the active compound combinations according to the invention in a concentration of 0.001 to 50% by weight, in particular 0.01 to 20% by weight.

Moreover, the antifouling compositions according to the invention comprise the customary components such as, for example, those described in Ungerer, *Chem. Ind.* 1985, 37, 730-732 and Williams, *Antifouling Marine Coatings*, Noyes, Park Ridge, 1973.

Besides the algicidal, fungicidal, molluscicidal active compounds and insecticidal active compounds according to the invention, antifouling paints comprise, in particular, binders.

Examples of recognized binders are polyvinyl chloride in a solvent system, chlorinated rubber in a solvent system, acrylic resins in a solvent system, in particular in an aqueous system, vinyl chloride/vinyl acetate copolymer systems in the form of aqueous dispersions or in the form of organic solvent systems, butadiene/styrene/acrylonitrile rubbers, drying oils such as linseed oil, resin esters or modified hardened resins in combination with tar or bitumens, asphalt and epoxy compounds, small amounts of chlorine rubber, chlorinated polypropylene and vinyl resins.

If appropriate, paints also comprise inorganic pigments, organic pigments or colorants which are preferably insoluble in saltwater. Paints may furthermore

comprise materials such as colophonium to allow controlled release of the active compounds. Furthermore, the paints may comprise plasticizers, modifiers which affect the rheological properties and other conventional constituents. The compounds according to the invention or the abovementioned mixtures may also be incorporated
5 into self-polishing antifouling systems.

The active compound combinations are also suitable for controlling animal pests, in particular insects, arachnids and mites, which are found in enclosed spaces such as, for example, dwellings, factory halls, offices, vehicle cabins and the like. They can be
10 employed in domestic insecticide products for controlling these pests. They are active against sensitive and resistant species and against all developmental stages. These pests include:

From the order of the Scorpionidea, for example, *Buthus occitanus*.

From the order of the Acarina, for example, *Argas persicus*, *Argas reflexus*, *Bryobia*
15 *ssp.*, *Dermanyssus gallinae*, *Glyciphagus domesticus*, *Ornithodoros moubat*, *Rhipicephalus sanguineus*, *Trombicula alfreddugesi*, *Neutrombicula autumnalis*, *Dermatophagoides pteronissimus*, *Dermatophagoides forinae*.

From the order of the Araneae, for example, *Aviculariidae*, *Araneidae*.

From the order of the Opiliones, for example, *Pseudoscorpiones chelifer*,
20 *Pseudoscorpiones cheiridium*, *Opiliones phalangium*.

From the order of the Isopoda, for example, *Oniscus asellus*, *Porcellio scaber*.

From the order of the Diplopoda, for example, *Blaniulus guttulatus*, *Polydesmus*
spp..

From the order of the Chilopoda, for example, *Geophilus spp.*

25 From the order of the Zygentoma, for example, *Ctenolepisma spp.*, *Lepisma saccharina*, *Lepismodes inquilinus*.

From the order of the Blattaria, for example, *Blatta orientalis*, *Blattella germanica*,
Blattella asahinai, *Leucophaea maderae*, *Panchlora spp.*, *Parcoblatta spp.*, *Periplaneta*
australasiae, *Periplaneta americana*, *Periplaneta brunnea*, *Periplaneta fuliginosa*,
30 *Supella longipalpa*.

From the order of the Saltatoria, for example, *Acheta domesticus*.

From the order of the Dermaptera, for example, *Forficula auricularia*.

From the order of the Isoptera, for example, *Kaloterms* spp., *Reticulitermes* spp..

From the order of the Psocoptera, for example, *Lepinatus* spp., *Liposcelis* spp..

5 From the order of the Coleptera, for example, *Anthrenus* spp., *Attagenus* spp.,
Dermestes spp., *Latheticus oryzae*, *Necrobia* spp., *Ptinus* spp., *Rhizopertha dominica*,
Sitophilus granarius, *Sitophilus oryzae*, *Sitophilus zeamais*, *Stegobium paniceum*.

10 From the order of the Diptera, for example, *Aedes aegypti*, *Aedes albopictus*, *Aedes*
taeniorhynchus, *Anopheles* spp., *Calliphora erythrocephala*, *Chrysozona pluvialis*,
Culex quinquefasciatus, *Culex pipiens*, *Culex tarsalis*, *Drosophila* spp., *Fannia*
canicularis, *Musca domestica*, *Phlebotomus* spp., *Sarcophaga carnaria*, *Simulium*
spp., *Stomoxys calcitrans*, *Tipula paludosa*.

From the order of the Lepidoptera, for example, *Achroia grisella*, *Galleria mellonella*,
Plodia interpunctella, *Tinea cloacella*, *Tinea pellionella*, *Tineola bisselliella*.

15 From the order of the Siphonaptera, for example, *Ctenocephalides canis*,
Ctenocephalides felis, *Pulex irritans*, *Tunga penetrans*, *Xenopsylla cheopis*.

From the order of the Hymenoptera, for example, *Camponotus herculeanus*, *Lasius*
fuliginosus, *Lasius niger*, *Lasius umbratus*, *Monomorium pharaonis*, *Paravespula*
spp., *Tetramorium caespitum*.

20 From the order of the Anoplura, for example, *Pediculus humanus capitis*, *Pediculus*
humanus corporis, *Phthirus pubis*.

From the order of the Heteroptera, for example, *Cimex hemipterus*, *Cimex*
lectularius, *Rhodinus prolixus*, *Triatoma infestans*.

25 They are used as aerosols, pressure-free spray products, for example pump and
atomizer sprays, automatic fogging systems, foggers, foams, gels, evaporator
products with evaporator tablets made of cellulose or polymer, liquid evaporators, gel
and membrane evaporators, propeller-driven evaporators, energy-free, or passive,
evaporation systems, moth papers, moth bags and moth gels, as granules or dusts, in
baits for spreading or in bait stations.

30 All plants and plant parts can be treated in accordance with the invention. Plants are
to be understood as meaning in the present context all plants and plant populations

such as desired and undesired wild plants or crop plants (inclusive of naturally occurring crop plants). Crop plants can be plants which can be obtained by conventional plant breeding and optimization methods or by biotechnological and genetical engineering or by combinations of these methods, inclusive of the transgenic plants and inclusive of the plant varieties protectable or not protectable by plant breeders' rights, such as shoot, leaf, flower and root, examples which may be mentioned being leaves, needles, stalks, stems, flowers, fruit bodies, fruits, seeds, roots, tubers and rhizomes. The plant parts also include harvested material, and vegetative and generative propagation material, for example cuttings, tubers, rhizomes, offsets and seeds.

Treatment according to the invention of the plants and plant parts with the active compounds is carried out directly or by allowing the compounds to act on the surroundings, environment or storage space by the customary treatment methods, for example by immersion, spraying, evaporation, fogging, scattering, painting on and, in the case of propagation material, in particular in the case of seed, also by applying one or more coats.

As already mentioned above, it is possible to treat all plants and their parts according to the invention. In a preferred embodiment, wild plant species and plant varieties, or those obtained by conventional biological breeding, such as crossing or protoplast fusion, and parts thereof, are treated. In a further preferred embodiment, transgenic plants and plant varieties obtained by genetical engineering, if appropriate in combination with conventional methods (Genetic Modified Organisms), and parts thereof are treated. The term "parts" or "parts of plants" or "plant parts" has been explained above.

Particularly preferably, plants of the plant varieties which are in each case commercially available or in use are treated according to the invention.

Depending on the plant species or plant varieties, their location and growth conditions (soils, climate, vegetation period, diet), the treatment according to the invention may also result in superadditive ("synergistic") effects. Thus, for example, reduced application rates and/or a widening of the activity spectrum and/or an increase in the activity of the substances and compositions which can be used according to the invention, better plant growth, increased tolerance to high or low temperatures, increased tolerance to drought or to water or soil salt content, increased flowering performance, easier harvesting, accelerated maturation, higher harvest yields, better quality and/or a higher nutritional value of the harvested products, better storage stability and/or processability of the harvested products are possible which exceed the effects which were actually to be expected.

The transgenic plants or plant varieties (i.e. those obtained by genetical engineering) which are preferred and to be treated according to the invention include all plants which, in the genetic modification, received genetic material which imparts particularly advantageous useful properties ("traits") to these plants. Examples of such properties are better plant growth, increased tolerance to high or low temperatures, increased tolerance to drought or to water or soil salt content, increased flowering performance, easier harvesting, accelerated maturation, higher harvest yields, better quality and/or a higher nutritional value of the harvested products, better storage stability and/or processability of the harvested products. Further and particularly emphasized examples of such properties are a better defence of the plants against animal and microbial pests, such as against insects, mites, phytopathogenic fungi, bacteria and/or viruses, and also increased tolerance of the plants to certain herbicidally active compounds. Examples of transgenic plants which may be mentioned are the important crop plants, such as cereals (wheat, rice), maize, soya beans, potatoes, cotton, oilseed rape and also fruit plants (with the fruits apples, pears, citrus fruits and grapevines), and particular emphasis is given to maize, soya beans, potatoes, cotton and oilseed rape. Traits that are particularly emphasized are increased defence of the plants against insects by toxins formed in the plants, in particular those formed by the genetic material from *Bacillus thuringiensis* (for

example by the genes CryIA(a), CryIA(b), CryIA(c), CryIIA, CryIIIA, CryIIIB2, Cry9c Cry2Ab, Cry3Bb and CryIF and also combinations thereof) (hereinbelow referred to as "Bt plants"). Traits that are furthermore particularly emphasized are the increased tolerance of the plants to certain herbicidally active compounds, for example imidazolinones, sulphonylureas, glyphosate or phosphinotricin (for example the "PAT" gene). The genes which impart the desired traits in question can also be present in combination with one another in the transgenic plants. Examples of "Bt plants" which may be mentioned are maize varieties, cotton varieties, soya bean varieties and potato varieties which are sold under the trade names YIELD GARD® (for example maize, cotton, soya beans), KnockOut® (for example maize), StarLink® (for example maize), Bollgard® (cotton), Nucotn® (cotton) and NewLeaf® (potato). Examples of herbicide-tolerant plants which may be mentioned are maize varieties, cotton varieties and soya bean varieties which are sold under the trade names Roundup Ready® (tolerance to glyphosate, for example maize, cotton, soya bean), Liberty Link® (tolerance to phosphinotricin, for example oilseed rape), IMI® (tolerance to imidazolinones) and STS® (tolerance to sulphonylurea, for example maize). Herbicide-resistant plants (plants bred in a conventional manner for herbicide tolerance) which may be mentioned include the varieties sold under the name Clearfield® (for example maize). Of course, these statements also apply to plant varieties having these or still to be developed genetic traits, which plants will be developed and/or marketed in the future.

The plants listed can be treated according to the invention in a particularly advantageous manner with the active compound mixtures according to the invention. The preferred ranges stated above for the mixtures also apply to the treatment of these plants. Particular emphasis is given to the treatment of plants with the mixtures specifically mentioned in the present text.

The good insecticidal and acaricidal action of the active compound combinations according to the invention can be seen from the examples which follow. While the

individual active compounds show weaknesses in their action, the combinations show an action which exceeds a simple sum of actions.

5 A synergistic effect in insecticides and acaricides is always present when the action of the active compound combinations exceeds the total of the actions of the active compounds when applied individually.

10 The expected action for a given combination of two active compounds can be calculated as follows, using the formula of S.R. Colby, Weeds 15 (1967), 20-22:

If

15 X is the kill rate, expressed as % of the untreated control, when employing active compound A at an application rate of m g/ha or in a concentration of m ppm,

20 Y is the kill rate, expressed as % of the untreated control, when employing active compound B at an application rate of n g/ha or in a concentration of n ppm and

E is the kill rate, expressed as % of the untreated control, when employing active compounds A and B at application rates of m and n g/ha or in a concentration of m and n ppm,

25 then

$$E = X + Y - \frac{X \cdot Y}{100}$$

30 If the actual insecticidal kill rate exceeds the calculated value, the action of the combination is superadditive, i.e. a synergistic effect is present. In this case, the

actually observed kill rate must exceed the value calculated using the above formula for the expected kill rate (E).

5 After the desired period of time, the kill in % is determined. 100% means that all animals have been killed; 0% means that none of the animals have been killed.

Example

Critical concentration test/soil insects – treatment of transgenic plants

5

Test insect: **Diabrotica balteata – larvae in soil**

Solvent: 7 parts by weight of acetone

Emulsifier: 1 part by weight of alkylaryl polyglycol ether

10

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amount of solvent, the stated amount of emulsifier is added and the concentrate is diluted with water to the desired concentration.

15

The preparation of active compound is poured onto the soil. Here, the concentration of the active compound in the preparation is virtually irrelevant, only the amount by weight of active compound per volume unit of soil, which is stated in ppm (mg/l), matters. The soil is filled into 0.25 l pots and these are allowed to stand at 20°C.

20

Immediately after preparation, 5 pre-germinated maize corns of the variety YIELD GUARD (trade mark of Monsanto Comp., USA) are placed into each pot. After 2 days, the test insects in question are placed into the treated soil. After a further 7 days, the efficacy of the active compound is determined by counting the maize plants that have emerged (1 plant = 20% efficacy).

25

Example

Heliothis virescens test - treatment of transgenic plants

- 5 Solvent: 7 parts by weight of acetone
Emulsifier: 1 part by weight of alkylaryl polyglycol ether

10 To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amount of solvent and the stated amount of emulsifier, and the concentrate is diluted with water to the desired concentration.

15 Soya bean shoots (glycine max) of the variety Roundup Ready (trade mark of Monsanto Comp. USA) are treated by being dipped into the preparation of active compound of the desired concentration and are populated with the tobacco budworm *Heliothis virescens* while the leaves are still moist.

After the desired period of time, the kill of the insects is determined.